DISSERTATION ON

A CRITICAL AND COMPREHENSIVE ANALYSIS OF TRAUMATIC POSTERIOR FOSSA EXTRA DURAL HAEMATOMAS

M.Ch. Degree Examination

Branch II Neurosurgery

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CERTIFICATE

This is to certify that the dissertation entitled **"A CRITICAL AND COMPREHENSIVE ANALYSIS OF TRAUMATIC POSTERIOR FOSSA EXTRA DURAL HAEMATOMAS"** was done under our supervision and is the bonafide work of Dr.K.V.KARTHIKEYAN. It is submitted in partial fulfillment for the M.Ch Neuro surgery Examination.

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AIM OF THE STUDY

To conduct a critical and a comprehensive analysis of Traumatic Posterior fossa extra-dural haematomas with special reference to management options.

INTRODUCTION

Posterior fossa injury is relatively uncommon and accounts for less than 3% of all head injuries. Among traumatic posterior fossa injuries EDH is the most common, accounting for 10% of all EDHs.

In Pre CT era, Posterior Fossa Extra-dural Haematomas (PFEDH) were rarely diagnosed in alive patients. It was very difficult to diagnose based on clinical picture alone .It is unfortunate since it is an easily preventable cause of mortality.

From the early days, these lesions had a very high morbidity and mortality rates. Improvement in diagnostic methods, management protocols: and treatment modalities have resulted in substantial reduction in mortality and morbidity and improvement in outcome.

This study was undertaken to achieve these goals in the management of PFEDH.

REVIEW OF LITERATURE

There are many retrospective analysis conducted by pioneering authors on the presentation of PFEDH, radiological characteristics, guidelines and protocols for surgical and conservative management for PFEDH.

Article by Mahajan et al (12) - 1983; studied retrospectively, nineteen surgically treated PFEDH patients with relevance to clinical characteristics and final outcome. He observed a mortality rate of 15%. He concluded that admission GCS and associated intra cranial injuries determine higher mortality rate. He documented good recovery in patients with admission GCS of 13 to 15

In an another study in India by Mohanty et al (13)-1995, conducted on 24 surgically treated PFEDH .He reported higher incidence of PFEDH in CHILDREN - 11%., compared to ADULTS - 3%. He concluded that PFEDH had better outcome than supra-tentorial EDH, in both pediatric and adult age group. This above finding is not reported in any other study conducted on PFEDH.

A Large study by Lui et al (11) -1983 , based on surgically treated PFEDH patients, concluded that mortality was inversely related to pre-operative GCS and directly related to the age of the patient. Presence of other associated injury was associated with a higher mortality.

Another study of 73 surgically and non-surgically managed PFEDH, conducted by Bozbuga et al(1)-1999 reviewed surgical decision making based on CT criterias. He concluded that all the patients with presence of mass effect in CT over ventricular system should be treated surgically, a criteria published in almost all studies about PFEDH. Sub-acute clinical presentation resulted in lesser morbidity and mortality when compared with acute presentation.

Karasawa et al (8)-1997, in a class III study evaluated surgically treated patients with presence or absence of hydrocephalus and its impact on the final outcome. He concluded that bilateral lesions and clot thickness more than 15 mm were associated with higher mortality rate. He also documented that presence of hydrocephalus and temporary placement of Extra ventricular drainage did not significantly alter the mortality and morbidity of the patients.

Pozatti et al. (12)-1982 study comprising of 32 surgically and non - surgically treated patients concluded that presence of associated intra-cranial lesions correlated with poor outcome when compared with pure PFEDH.

Brambilla et al (3)-1983 in his study on surgically treated PFEDH patients concluded that Brainstem and Basal ganglia injury resulted in higher mortality. A similar study by Ciurea et al (4)-1993 observed the same conclusion

Holzschuch and Schunknecht et al (7)-1989 evaluated the clinical and radiologic characteristics with outcome and concluded that all patients with clinical signs of occipital trauma should be subjected to CT SCAN Brain in order to diagnose or rule out PFEDH as early as possible to prevent morbidity and mortality.

Koc et al. (10) -1998. concluded in his study that lesion size , presence of co-existing intra cranial lesions and increasing age were not associated with prognosis. But the major drawback of this study was that all the patients were not evaluated with CT.

Thus it is found on reviewing the literature, that there are no controlled, prospective clinical trials , using surgical versus non-surgical management of PFEDH. The available data support rapid evacuation of PFEDH that i) show evidence of mass effect or (ii) result in progressive neurological dysfunction. The published data so far support expectant management with the serial imaging for those cases in which there is neurological stability and no radiological evidence for mass effect.

Hence this study concentrates on latter group and attempts to device a management plan in the group of PFEDH with no mass effect, and or no clinical deterioration. In addition, this study analyses the effects of various variables like shallow posterior fossa, associated injuries, volume of EDH, presence or absence of occipital fracture, location of fracture, GCS etc in PFEDH patients..

STUDY MATERIALS AND METHODS

This study was conducted on all the patients admitted with the diagnosis of PFEDH between May 2003 and July 2006 at the Madras Institute of Neurology, Madras medical college and Government General hospital, Chennai. As per above criteria a total number of 69 patients were enrolled in this study.

Exclusion Criterias:

1. Patients who died before surgery.
2. Patients who were initially admitted in another hospital and then later referred here were excluded due to lack of exact information regarding clinical condition of the patients.
3. Patients who were not willing for surgery when indicated .
4. Patients who could not be operated because of poor hemodynamic status.
5. Patients who did not complete the entire management protocol in this hospital
6. Associated intracranial head injury, which required surgery other than PFEDH were excluded from this study.
7. Patients who underwent surgery for PFEDH in some other hospital and referred here for further management were excluded

A total of 15 patients were excluded from this study. The remaining 54 patients were enrolled in this study.

A Proforma was formulated to conduct this study and all the patients enrolled in the study had their necessary parameters filled up in the proforma. The proforma contained all the necessary informations required for conducting the study.

All the patients admitted were critically evaluated for their post resuscitation GCS, age, sex, presence or absence of FND, presence or absence of other associated injuries. A complete neurological examination was conducted wherever possible.

All the patients were subjected to X ray of skull AP and Lateral view and Towne's view .All the patients underwent CT brain with 5 mm PF thickness slices with bone window. All the patients had X ray cervical spine and the relevant investigation of the required area was done based on the associated injuries presnt

All the necessary investigations were repeated as and when necessary including CT scan Brain based on clinical progress and clinical condition of the patients.

Based on CT images location of the clot, volume of the clot (ml), presence or absence of mass effect on 4th ventricle with or without dilatation of ventricles, occipital bone injuries including fracture and other intracranial injuries were documented in the proforma everytime a CT brain was taken.

After evaluation , the patients were divided into three groups namely,

Group I Initial surgical management

Group II Conservative management

Group III Initially planned for conservative then treated with surgery

Group I had 14 patients

Group II had 32 patients

Group III had 8 patients

All patients who required surgery (Group I) were assessed for anaesthetic fitness based on hemodynamic status and blood parameters. They were subjected to surgery as early as possible. A standard sub occipital burr hole craniectomy and clot evacuation was performed on relevant area and side. All the information obtained during surgery were noted in the proforma.

All the patients in Group II were planned for conservative management and periodic assessment of GCS, development of fresh FND ,B.P assessment, bradycardia and respiratory abnormality were done.

Routine repeat CT was taken at 6 hours after injury or whenever a new clinical sign developed. (ex. low GCS, bradycardia , FND or bradypnoea)

Based on the above information a master chart was prepared. A critical statistical analysis of the master chart was done using (i) Chi-square test, (ii) One way Anova. (iii) Post Hoc test. (iv) Paired T test (v) Independent T test and the results are discussed in the following pages.

PROFORMA AND MASTER CHART

PROFORMA

Name | Date & Time of injury

Age | Date & time of admission

Sex | Date of surgery (if done)

I.P. No

M.I.N. No

	On admission	On deterioration	on discharge
GCS			

No. of CT scans done :

CT findings	CT -1	CT -2
1. Date		
2. Volume in ml		
3. Presence or absence of ventricular system dysfunction		
4. +/- of Occipital bone injury		

Presence or absence of shallow PF

Presence or absence of high cervical injury

Associated injury | Group of the patient

MASTER CHART

SURGERY GROUP - GROUP I

No.	*Age*	*Sex*	*GCS*	*CT/EDH Volume (ml)*	*Ass. Injury*	*Mass effect on Ventricular System*	*Focal Deficit Due to EDH*	*High Cervical Injury*	*+/- of shallow PF*	*+/- of Occipital #*	*Mortality*
1.	11	F	7	12	–	–	B.S. (+)	–	–	+	
2.	28	M	6	17	–	+	B.S. (+)	–	+	+	
3.	41	M	5	16	–	+	B.S. (+)	–	+	+	
4.	16	M	13	12	–	–	–	–	–	+	
5.	64	M	5	24	+	+	B.S. (+)	+	–	+	+
6.	40	M	14	13	–	–	C.S. (+)	–	–	+	
7.	25	F	4	22	+	+	B.S. (+)	+	+	+	+
8.	36	M	9	13	–	+	C.S. (+)	–	+	+	
9.	18	F	11	12	–	+	C.S. (+)	–	–	+	
10.	8	M	12	14	–	+	C.S. (+)	–	–	+	
11.	32	F	8	12	–	+	C.S. (+)	–	–	+	
12.	51	F	10	11	–	–	C.S. (+)	–	+	+	
13.	4	F	15	10	–	+	–	–	–	+	
14.	21	F	10	12	–	–	C.S. (+)	–	+	+	

CONSERVATIVE GROUP - GROUP II

No.	*Age*	*Sex*	*GCS*	*CT/EDH Volume (ml)*	*Ass. Injury*	*Mass effect on Ventricular System*	*Focal Deficit Due to EDH*	*High Cervical Injury*	*+/- of shallow PF*	*+/- of Occipital #*	*Mortality*
1.	62	M	4	3	+	+	B.S.	+	–	+	+
2.	3	M	12	3	–	–	–	–	+	–	
3.	24	F	15	6	–	–	–	–	+	–	
4.	18	F	13	5	–	–	–	–	+	–	
5.	6	M	8	4	+	–	–	–	–	–	
6.	9	M	6	3	–	–	B.S (+)	–	–	–	
7.	33	M	14	5	–	–	–	–	+	+	
8.	24	F	10	4	–	–	–	–	–	+	
9.	44	M	15	6	–	–	–	–	–	+	
10.	1½	F	13	3	–	–	–	–	–	+	
11.	37	M	15	7	–	–	–	+	+	+	
12.	11	M	14	7	–	–	–	–	–	+	
13.	40	F	7	6	+	–	–	–	+	+	
14.	13	M	15	6	–	–	–	–	–	+	
15.	48	M	11	7	–	–	–	–	+	+	
16.	4	M	14	8	–	–	–	–	–	+	
17.	53	F	13	7	+	–	–	–	+	+	

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No.	*Age*	*Sex*	*GCS*	*CT/EDH Volume (ml)*	*Ass. Injury*	*Mass effect on Ventricular System*	*Focal Deficit Due to EDH*	*High Cervical Injury*	*+/- of shallow PF*	*+/- of Occipital #*	*Mortality*
18.	30	M	5	7	+	–	–	+	–	+	
19.	42	M	15	6	–	–	–	–	+	+	
20.	60	F	9	4	–	–	–	–	–	+	
21.	21	M	14	6	–	–	–	–	+	+	
22.	49	F	13	6	–	–	–	–	–	+	
23.	23	F	14	7	–	–	–	–	+	+	
24.	35	F	15	7	–	–	–	–	–	+	
25.	50	M	14	6	+	–	–	–	–	+	
26.	19	F	5	6	+	–	–	–	–	+	
27.	57	M	13	4	–	–	–	–	+	+	
28.	39	F	15	7	–	–	–	+	–	+	
29.	51	M	12	5	–	–	–	–	+	+	
30.	7	F	13	4	–	–	–	–	–	+	
31.	40	F	14	5	–	–	–	–	+	+	
32.	27	M	8	4	+	–	–	–	–	+	

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INITIAL CONSERVATIVE THEN SURGERY - GROUP III

No.	*Age*	*Sex*	*GCS*		*Volume*		*Associate Injury*	*Mass effect on Ventricular System*		*Focal Deficit*		*High Cervical Injury*	*+/- of shallow PF*	*+/- of occipital*	*Mortality*
			AT Adm	*After Det*	*1st Ct*	*2nd CT*		*Before*	*After*	*Before*	*After*				
1.	16	M	10	8	5	14	–	–	+	–	CS+	–	–	+	
2.	6	F	14	14	6	12	–	–	+	–	CS+	–	+	+	
3.	60	M	9	8	7	13	–	–	+	–	CS+	–	+	+	
4.	23	F	13	4	6	17	–	–	+	–	CS+	+	–	+	+
5.	38	M	7	7	8	18	–	–	+	–	BS+	–	+	+	
6.	3	F	8	5	6	14	–	–	–	–	CS+	–	–	+	
7.	78	M	7	5	4	13	–	–	+	–	BS+	–	+	+	+
8.	43	M	9	7	6	17	–	–	+	–	BS+	–	–	+	

RESULTS AND ANALYSIS OF RESULTS

Results

Table 1 : Group Vs Mortality

Crossta

Coun

		Group			
		Surgery	Conservative	Cons. then Surgery	Total
Mortality	-	12	31	6	49
	+	2	1	2	5
Total		14	32	8	54

Not Significant

Table 2 : Group Vs Sex

Crosstab

Count

		Group			
		Surgery	Conservative	Cons. then Surgery	Total
Sex	F	7	14	3	24
	M	7	18	5	30
Total		14	32	8	54

Not Significant

Table 3 : Group Vs Associated Injury

Crosstab

Count

		Group			
		Surgery	Conservative	Cons. then Surgery	Total
Associated Injury	–	12	24	8	44
	+	2	8	0	10
Total		14	32	8	54

Not Significant

Table 4 : Group Vs Initial Volume

Count

		Group			
		Surgery	Conser-vative	Cons. then Surgery	Total
Ventricular Dysfunction	–	5	3	8	4
	+	9	1	0	1
Total		1	3	8	5

Not Significant

Table 5. Group Vs FND

Count

		Group			
		Surgery	Conser-vative	Cons.then Surgery	Total
Focal	–	2	3	8	4
	+	1	2	0	1
Total		1	3	8	5

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	35.310[a]	2	.000
Likelihood Ratio	35.360	2	.000
N of Valid Cases	54		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 2.07.

Significant

Table 6 - Group Vs Cervical Spine Injury

Count

		Group			
		Surgery	Conservative	Cons. then Surgery	Total
High Cervical Injury	–	12	28	7	47
	+	2	4	1	7
Total		14	32	8	54

Not Significant

Table 7 - Groups Vs Shallow PF

Count

		Group			
		Surgery	Conservative	Cons. then Surgery	Total
+/- of shallow PF	–	8	18	4	30
	+	6	14	4	24
Total		14	32	8	54

Not Significant

Table 8 - Group Vs Occipital Bone Injury

Count

		Group			
		Surgery	Conservative	Cons. then Surgery	Total
+/- of occipital	–	0	5	0	5
	+	14	27	8	49
Total		14	32	8	54

Not Significant

Table 9 - Group Comparison of Age / GCS / Volume

	Surgery (n = 14)		Conservative (n = 32)		Cons. then Surgery (n=8)	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Age	28.2	17.0	30.6	18.2	33.3	26.4
GCS	9.2	3.5	11.	3.4	9.6	2.6
Volume	14.	4.1	5.4	1.4	6.0	1.1

Table 10 - ANOVA table for Group Comparison

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Age	Between Groups	139.526	2	69.763	.188	.830
	Within Groups	18968.349	51	371.928		
	Total	19107.875	53			
GCS	Between Groups	79.041	2	39.521	3.505	.037
	Within Groups	575.107	51	11.277		
	Total	654.148	53			
Volume	Between Groups	793.416	2	396.708	67.727	.000
	Within Groups	298.732	51	5.857		
	Total	1092.148	53			

Age - Not significant

GCS - Significant

Volume - Significant

Table 11 A - Positive list for Group Comparison

Dependent Variable	(I) Group	(J) Group	Significant
Age	Surgery	Conservative	-
		Cons. then surgery	-
	Conservative	Surgery	-
		Cons. then Surgery	-
	Cons. then Surgery	Surgery	-
		Cons. then Surgery	-
GCS	Surgery	Conservative	+
		Cons. then surgery	-
	Conservative	Surgery	+
		Cons. then Surgery	-
	Cons. then Surgery	Surgery	-
		Cons. then Surgery	-
Volume	Surgery	Conservative	+
		Cons. then surgery	+
	Conservative	Surgery	+
		Cons. then Surgery	-
	Cons. then Surgery	Surgery	+
		Cons. then Surgery	-

* The mean differences is significant at the .05 level

Table 12 - Pre and Post Deterioration value comparison			
		Mean	Significance
Pair 1	GCS	9.63	+
	GCS After	7.25	
Pair 2	Volume	6.00	+
	Volume After	14.75	

Table 13 - Post Deterioration Comparison in between Groups

Descrip

	Surgery (n = 14)		Conservative (n = 32)		Cons. then surgery (n = 8)	
	Me	Std.	Me	Std.	Me	Std.
GCS	9.	3.5	11.	3.4	7.	3.1
Volume	14.	4.1	5.	1.4	14.	2.2

Table 13 A - ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
GCS After	Between Groups	162.694	2	81.347	6.976	.002
	Within Groups	594.732	51	11.661		
	Total	757.426	53			
Volume After	Between Groups	1061.101	2	530.551	83.453	.000
	Within Groups	324.232	51	6.357		
	Total	1385.333	53			

Significant

Table 14 - Post Hoc Test for comparison Among Groups

Dependent Variable	(I) Group	(J) Group	Significant
GCS After	Surgery	Conservative	-
		Cons. then surgery	-
	Conservative	Surgery	-
		Cons. then Surgery	+
	Cons. then Surgery	Surgery	-
		Cons. then Surgery	+
Volume After	Surgery	Conservative	+
		Cons. then surgery	-
	Conservative	Surgery	+
		Cons. then Surgery	+
	Cons. then Surgery	Surgery	-
		Cons. then Surgery	+

Table 15 - Ventricular Dysfunction Vs Mortality

Count

		Groups			Total	Sig
		Surgery	Conservative	Cons. then Surgery		
Ventricular	-	8	31	1	37	+
After	+	9	1	7	17	+
Total		14	32	8	54	+

Table 15a - Chi - Square Tests

	Value	df		Sig
Pearson Chi -Square	30.551[a]	2	.000	+
Likelihood Ratio	34.096	2	.000	+
N of Valid Cases	54			

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 2.52

Table 16 - FND Vs Group Comparison

Count

		Group			
		Surgery	Conservative	Cons. then Surgery	Total
Focal Deficit After	–	2	30	0	32
	+	12	2	8	22
Total		14	32	8	54

Table 16a - Chi - Square Tests

	Value	df		Sig
Pearson Chi -Square	39.133[a]	2	.000	+
Likelihood Ratio	46.551	2	.000	+
N of Valid Cases	54			

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 3.26

Table 17 Associated Injury and Mortality

Count

		Mortality		
		-	+	Total
Associated Injury	–	42	2	44
	+	7	3	10
Total		49	5	54

Table 17a - Chi - Square Tests			
	Value	df	Sig
Pearson Chi -Square	6.284[b]	1	+
Continuity Correction	3.619	1	+
Likelihood Ratio	4.828	1	+
Fisher's Exact Test N of Valid Cases	54		+

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 93

Table 18 - Ventricular dysfunction Vs Mortality

Count

		Mortality		Total
		-	+	
Ventricular System Dysfunction	–	42	2	44
	+	7	3	10
Total		49	5	54

Table 18 A

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.284[b]	1	.012		
Continuity Correction[a]	3.619	1	.057		
Likelihood Ratio	4.828	1	.028		
Fisher's Exact Test				.039	.039
N of Valid Cases	54				

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .93.

Significant

Table 19 - FND Vs Mortality

Count

		Mortality		Total
		-	+	
Focal Deficit	–	38	2	40
	+	11	3	14
Total		49	5	54

Table 19 A

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.331[b]	1	.068		
Continuity Correction[a]	1.663	1	.197		
Likelihood Ratio	2.888	1	.089		
Fisher's Exact Test				.103	.103
N of Valid Cases	54				

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1. 30.

Significant

Table 20 - High Cervical Injury Vs Mortality

Count

		Mortality		
		-	+	Total
High Cervical Injury	–	46	1	47
	+	3	4	7
Total		49	5	54

Table 20 A

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	21.948[b]	1	.000		
Continuity Correction[a]	15.888	1	.000		
Likelihood Ratio	14.078	1	.000		
Fisher's Exact Test				.001	.001
N of Valid Cases	54				

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .65.

Significant

Table 21 +/- of shallow PF Vs Mortality

Count

		Mortality		
		-	+	Total
+/- of shallow PF	–	27	3	30
	+	22	2	24
Total		49	5	54

Significant

Table 21 A

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.044[b]	1	.834		
Continuity Correction[a]	.000	1	1.000		
Likelihood Ratio	.044	1	.833		
Fisher's Exact Test				1.000	.607
N of Valid Cases	54				

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2. 22.

Not Significant

Table 22 +/- of occipital # Vs Mortality

Count

		Mortality		
		-	+	Total
+/- of occipital	–	5	0	5
	+	44	5	49
Total		49	5	54

Table 22 A

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.562[b]	1	.453		
Continuity Correction[a]	.000	1	1.000		
Likelihood Ratio	1.022	1	.312		
Fisher's Exact Test				1.000	.603
N of Valid Cases	54				

a. Computed only for a 2x2 table

b. 3 cells (75.0%) have expected count less than 5. The minimum expected count is .46.

Not Significant

Table 23 - Ventricular System Dysfunction Vs Group

Count

		Group			
		Surgery	Conservative	Cons. then Surgery	Total
Ventricular System Dysfunction	–	5	31	8	44
	+	9	1	0	10
Total		14	32	8	54

Table 23 A

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.278[a]	2	.000
Likelihood Ratio	24.601	2	.000
N of Valid Cases	54		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 1.48.

Not Significant

Table 24 - Associate of Injury Vs mortality

	Mortality			
	Alive (n = 49)		Died (n = 5)	
	Mean	Std. Deviation	Mean	Std. Deviation
Age	28.378	17.3387	50.400	24.8857
Volume	7.41	3.476	11.80	10.305
GCS	11.24	3.224	6.60	3.782
GCS After	11.08	3.396	4.40	.548
Volume After	8.43	4.233	15.80	8.349

Table 24 A

	t-test for Equality of Means		
	t	df	Sig. (2-tailed)
Age	-2.601	52	.012
Volume	-2.128	52	.038
GCS	3.025	52	.004
GCS After	4.357	52	.000
Volume After	-3.355	52	.001

Significant

Table 25 Sex Vs Mortality

Count

		Mortality		
		Alive	Died	Total
Sex	F	22	2	24
	M	27	3	30
Total		49	5	54

Not Significant

Table 26 One way ANOVA

	< 15 (n = 13)		15 - 30 (n = 15)		30 - 50 (n = 17)		> 50 (n=9)	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
GCS	11.62	3.203	10.07	3.693	11.76	3.492	9.11	3.296
GCS After	11.38	3.572	9.33	3.922	11.65	3.622	8.78	3.528
Volume	6.62	3.548	8.73	5.244	8.00	3.317	7.67	6.595
Volume After	7.69	4.270	10.07	5.561	9.24	4.521	9.33	6.764

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ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
GCS	Between Groups	58.190	3	19.397	1.627	.195
	Within Groups	595.958	50	11.919		
	Total	654.148	53			
GCS After	Between Groups	79.578	3	26.526	1.957	.133
	Within Groups	677.848	50	13.557		
	Total	757.426	53			
Volume	Between Groups	32.138	3	10.713	.505	.680
	Within Groups	1060.010	50	21.200		
	Total	1092.148	53			
Volume After	Between Groups	40.572	3	13.524	.503	.682
	Within Groups	1344.761	50	26.895		
	Total	1385.333	53			

Correlations

		GCS	Volume
GCS	Pearson Correlation	1	-.331*
	Sig. (2-tailed)	.	.014
	N	54	54
Volume	Pearson Correlation	-.331*	1
	Sig. (2-tailed)	.014	.
	N	54	54

*. Correlation is significant at the 0.05 level (2-tailed).

Not Significant

Table 27 Age Group Vs Mortality

Count

		Mortality		
		Alive	Died	Total
Age	< 15	13	0	13
	15 - 30	13	2	15
	30 - 50	17	0	17
	> 50	6	3	9
Total		49	5	54

Table 27 A

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.566[a]	3	.023
Likelihood Ratio	10.080	3	.018
Linear-by-Linear Association	3.217	1	.073
N of Valid Cases	54		

a. 4 cells (50.0%) have expected count less than 5. The minimum expected count is .83.

Significant

ANALYSIS OF RESULTS

Group I Evaluation of the parameters for the 14 patients revealed the following details

1 Age Group:

< 15	-	3
15 - 30	-	5
30 - 50	-	4
>50	-	2

2. Sex:

Male	-	8
Female	-	7

3. GCS

3 - 8	-	6
9 - 12	-	5
13-15	-	3

4. Volume : All the patients with a volume of more than 10 ml were subjected to surgery.

5. Associated injury was present only in 2 patients.

6. Ventricular system dysfunction was present in 9 out of 14 patients.

7. All the patients had FND either of Brain stem or cerebellar signs

8. High cervical spine injury was seen in 2 patients

9. Equal distribution of shallow PF was seen in this group

10. All the patients had occipital injury and the fracture was running over the transverse sinus.

11. Two out of the 14 patients died.

Group II

34 patients in this group were analysed with their parameters and it revealed,

1. Age Group

< 15	-	8
15 - 30	-	8
30 - 50	-	11
>50	-	5.

2. Sex

   Male - 18

   Female - 14

3. GCS

   3 - 8 - 8

   9 - 12 - 5

   13-15 - 19

4. All the patients with volume of < 10 ml were treated conservatively irrespective of other parameter

5. 8 of these patients had associated injuries

6. Occipital bone injury was seen in 27 patients

7. Mortality noted is 2

8. No patients had ventricular system dysfunction or FND

9. Equal distribution of shallow posterior fossa

Group III 8 patients in this group evaluated and showed ,

1. Age Group

< 15	-	2
15 - 30	-	2
30 - 50	-	2
>50	-	2

2. Sex

Male	-	5
Female	-	3

3. GCS (After deterioration)

3 - 8	-	7
9 - 12	-	Nil
13-15	-	1

4. Volume : any post deterioration value of more than 10 ml

5. Almost all patients had ventricular dysfunction and FND

6. Only one mortality occurred in this group

Table 1 Group Vs Mortality

It implies that out of 5 deaths Group I, II, III had 14%,3%,25% of deaths respectively which is not significant.

Table 2 Groups Vs Sex

All groups had equal sex distribution which again is not significant

Table 3 Group Vs Associated injury

8 Patients in Group I and, 2 patients in Group II had associated injuries which is not a significant value.

Table 4 Group vs mass effect on ventricles

Patients who underwent early surgery (Group I) had maximum number of associated ventricular dysfunction. But later 7 out of 8 patients in Group III had the same finding after deterioration which is significant.

Table 5 Group Vs FND

Out of 22 patients who had FND (in the form of either brain stem signs or cerebellar signs). Group I and Group III had 12 and 8 patients respectively

only 2 patients in group II had FND. Table 5a indicates significant association between these two factors.

Table 6 Group Vs Cervical spine injury

Shows out of 7 patients who had this injury group II had maximum of 4 patients which is not a significant association.

Table 7 Group Vs + / - of shallow PF

This shows presence of shallow PF is equally distributed in all Groups. This also is not a significant association.

Table 8 Group Vs Occipital bone injury

49 out of 54 patients had associated occipital bone injury and in all groups it is equally distributed. The one important finding is that all the patients who underwent surgery had occipital bone injury which invariably crossed transverse sinus.

Table 9 Group comparison with Age, GCS & Volume

There was not much of difference in the mean age distribution among the three groups. Whereas mean initial GCS and mean initial volume significantly differ among the groups.

Table 10 ANOVA table for Group comparison

Comparison of mean age, GCS and volume between the groups and within the group showed age has no significant comparison. But GCS and volume differ significantly .

Table 11 On evaluating further table 11 shows, based on GCS ,significant difference was noted in Group I and II. Also the analysis based on volume Group I significantly differs from both the other groups.

Table 12 Before and after deterioration comparison in Group III

In group III patients, initial GCS and initial volume when compared with that of post deterioration values, the difference for both the parameters were significant. In this volume had more significance than GCS.

Table 13 & 13a A Post deterioration comparison between the groups

When the post deterioration values for GCS and volume were compared with that of group I and II, there was significant difference among these groups for both the parameters. Mean GCS was 7.25 in patients who were operated after deterioration. Whereas mean GCS of 9.21 was noted in patients who were taken up for surgery as initial mode of management. The result concluded was patients who had an initial GCS of less than that of 12 in Group III had significant chance of deterioration when compared to patients, who had more than 12 GCS in the same group. When clot volume was analysed in Group III patients, patients who had volume of more than 5.54 had higher a chance of deterioration than those who had less than 5.54 ml volume.

Table 14 Post Hoc test for comparison among groups

When post deterioration values of GCS and volume were compared among the groups, it showed a significantly lower GCS in Group III than those of Group II. Whereas volume values of Group II patients were significantly lower than other groups.

Table 15 , 15 a , 16 , 16a ,23 & 23A

All these tables imply that after deterioration, patients in Group III had both FND and ventricular system dysfunction appearing as a new finding in all most all patients. The difference was highly significant for both the parameters. Because Group III patients had twice the percentage of mortality than Group I patients.

Table 17, 18, 19

Shows 60% of the patients who died in this study had ventricular dysfunction, associated injury or FND. These parameters were highly significant either independently or as a combination. Only 25% of the survived patients had these association.

Table 20

Shows that 80% of the patients who died in this study had high cervical injury whereas only 7% was seen among the survived patients. The above table infers that associate injuries, ventricular system dysfunction, high cervical

spine injury and FND were associated with higher mortality when present along with PFEDH.

Table 21, 21A

Presence or absence of shallow PF did not affect the mortality rate.

Table 22, 22A

Presence or absence of occipital bone injury did not affect mortality rate.

Table 24 implies the following findings,

i. Based on age, patients who were above 50 years of age experienced higher mortality rate than with age less than 28 year. This finding is independent of other parameters.

ii. Based on GCS, patients who had an initial GCS of less than 6.6 had higher mortality and an initial GCS more than 11.24 had lower mortality rates.

iii. Based on volume, patients who had an initial volume of more than 12 mm had higher mortality rate where as volume of less than 7.4 ml had better survival rate.

The conclusion made was, patients with initial volume of more than 7.41 ml (irrespective of GCS) and patient who had initial GCS of 11.24. When planned for conservative management had higher chance of deterioration. On

deterioration these patients had significantly higher mortality rate when compared to other patients in the same group.

All the findings in this table were highly significant and independent of other factors.

As per Table 27 : 30% of the patients above 50 years of age experienced mortality in this study which constitutes them as high risk age group independent of other factors.

DISCUSSION

Analysing the results with reference to each parameters separately result in the following informations.

1. The incidence of PFEDH did not vary among the various age groups and sex in this study.

2. There was no direct correlation between the size of PF and the EDH incidence .In other words it does not appear that shallow posterior fossa or cranio-vertebral junction anamolies show a predisposition towards development of PFEDH.

3. There was no direct correlation between cervical spine abnormality and injury with PFEDH incidence. But presence of cervical spine injury consistently resulted in poor outcome .This is probably because of the independent cervical cord injury resulting in respiratory and circulatory insufficiency

4. Radiological evidence of occipital bone injury extending above or beyond venous sinuses had a higher clot volume necessitating surgical decompression and evacuation. This is an important observation , particularly in those situations where only X ray of skull was available (in rural areas),since this calls for vigorous continuous further investigation and close observation.

5. Initial GCS & Age of the patient did not have any correlation with management option.

6. Patients who presented with FND either on admission or developed at a later stage invariably had higher clot volume necessitating surgical decompression and evacuation.

7. Associated cervical spine injury had no influence on management but significantly constitute to poor prognosis.

8. Clot volume of PFEDH is the single most significant indicator in the management options.

9. Patients presenting with mass effect in CT because of clot, invariably required surgical decompression and had significantly poor out come especially in group I and III.

10. All patients in Group 1 had a clot volume of ten ml and above. This is in continuity with the existing literature. Group III patients had initial clot volume between 7.5 ml and 10 ml.(i.e. the group which was initially put on conservative therapy and subsequently deteriorated).

Thus it is seen from our study that the safe volume for PFEDH is 7.5 ml rather than the usually accepted 10 ml, because all these patients who deteriorated and underwent surgery had poor outcome, when compared to conservatively managed Group or even compared to the Group which underwent direct surgery.

11. Concept of CRITICAL VOLUME INDEX [CVI} of PFEDH in adult patients.

In order to obviate the errors possible when one relies on absolute volume of EDH (because of inherent difference in the size of posterior fossa in different individuals) and because the clot volume is the single, most independent parameter in deciding surgical and non-surgical management options , it will be useful if a critical volume index be determined. This index can then be used as a guideline , irrespective of skull size . This index will be particularly useful in those situations where the clot is not producing mass effect.

This can be calculated by,

$$\text{CVI for PFEDH} = \frac{Clot\ volume}{Posterior\ fossa\ volume}$$

We have found out the average posterior fossa volume in adults and children from literature (from the article by SGOUROS et al in JNS, vol 105, 2006), and also independently measured it using normal child and adult skull. This study relies upon the value of the above mentioned literature because of the non availability of the diagnostic software for measuring posterior fossa volume in CT scan. For applying this index for practical purpose needs to be confirmed with larger studies.

Thus we found that

CVI for normal adult is 0.036.

If the index is more than 0.036 , then that is an absolute independent indicator for surgical evacuation

Regarding pediatric PFEDH and CVI further work needs to be done to find out the absolute volume of posterior fossa and critical volume of clot as an independent marker of surgical intervention. But mathematically we found that the critical volume of the clot for pediatric age group is 6.1 ml.. But one has to take into consideration, the non closure of suture and malleability of the skull while calculating the absolute volume. Larger studies are needed for calculating the absolute clot volume for PFEDH.

CONCLUSION

1. Sex, posterior fossa volume, occipital bone injury had no impact on final outcome.

2. Elderly patients had poor out come irrespective of volume and GCS.

3. Presence of associated injury and high cervical injury though did not influence the management, but constitute significantly to poor outcome.

4. Mass effect on 4 th ventricle or dilatation of ventricles and FND invariably required surgery and most of the patient usually had poor outcome.

5. Patient with GCS less than 7 had poor outcome irrespective of the group they are in

6. All the patient with GCS more than 11 had better outcome.

7. In conservative group patients with GCS of 8 to 11 constitute a high risk group for deterioration and poor outcome, if not subjected to surgery as an initial mode of management.

8. Clot volume of more than 12 ml had poor outcome irrespective of other factors.

9. Clot volume of lees than 5.4 ml had better out come.

10. In conservative group patients with clot volume of more than or equal to 7.4 ml for adult and 6.1 ml for children had higher chance of deterioration and subsequently had poor outcome if not subjected to surgery as an initial mode of management.

11. CVI for adult is 0.036

A adult patient with CVI of more than 0.036 deteriorate and subsequently had poor outcome if not subjected to surgery as an initial management.

On concluding, Patients in the conservative group who have

1. Age more than 50 years
2. Initial GCS of 8 to 12
3. Initial clot volume more than 7.4 ml
4. CVI more than 0.036

Should undergo surgery as an initial management option in order to obtain better prognosis and out come.

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